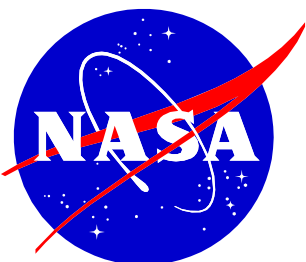


**GAMMA-RAY LARGE AREA
SPACE TELESCOPE
(GLAST)
PROJECT**

**INDEPENDENT REVIEW
PLAN**

January 2004



**GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND**

CHECK THE GLAST PROJECT WEBSITE AT
<http://glast.gsfc.nasa.gov/project/cm/mcdl> TO VERIFY THAT THIS IS THE CORRECT VERSION PRIOR TO USE.

**GLAST PROJECT
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**GLAST PROJECT
INDEPENDENT REVIEW PLAN**

Approved by:

Original Signed *04/06/04*

Kevin Grady Date
GLAST Project Manager

Original Signed *04/12/04*

Dr. D. Bryant Cramer Date
SEU/NMP Program Manager

Original Signed *04/21/04*

Richard M. Day Date
Deputy Director for Systems Management

Original Signed *04/27/04*

William F. Townsend Date
GSFC Program Management Council Chair

GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND

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1. GLAST Overview

GLAST is a next-generation high-energy gamma-ray observatory that will provide long-term observations of celestial gamma-ray sources in the approximate energy range extending from 10 keV to greater than 300 GeV. GLAST is designed for making studies of powerful gamma-ray phenomena such as neutron stars and black holes, interstellar gas in the galaxy that interact with high-energy cosmic rays, the diffuse extragalactic background, supernovae that may be sites of cosmic-ray acceleration, and the mysterious gamma-ray bursts. GLAST will also search for annihilation-line radiation from weakly interacting massive particles that may account for much of the dark matter in the universe. GLAST follows in the footsteps of NASA's Compton Gamma-Ray Observatory (CGRO) that was operational in 1991-1999.

GLAST will accomplish its mission through an imaging telescope that is much more capable than instruments flown previously, as well as a secondary instrument to augment the study of gamma-ray bursts. The main instrument, the Large Area Telescope (LAT), has superior area, angular resolution, field-of-view, and dead time that together will provide a factor of 30 or more advance in sensitivity, as well as provide capability for the study of transient phenomena. The LAT covers the energy range from 20 MeV to 300 GeV. The GLAST Burst Monitor (GBM) will have a field-of-view several times larger than the LAT and will provide spectral coverage of gamma-ray bursts that extends from the lower limit of the LAT down to 10 keV.

The Lead Center for the GLAST program is GSFC. The Governing Program Management Council (GPMC) is the NASA Headquarters PMC. Marshall Space Flight Center (MSFC) is responsible for providing the GBM instrument. NASA and the Department of Energy (DOE) have joint responsibility for the LAT, which is being managed by the Stanford Linear Accelerator Center (SLAC).

2. GLAST Independent Reviews

In accordance with GPG 8700.4, this plan documents the GLAST reviews that will be chaired or supported by the GSFC System Review Office (SRO). The planned reviews and the purpose of each review are listed in Table 1. This table also includes reviews planned to be conducted by GLAST's Headquarters-chartered Independent Review Team (described below) and other gateway reviews. Table 2 shows the review teams that will participate in each review and lists the Chair or Co-chair. The specific dates and locations may change as the project evolves. SRO "Chair" indicates that the review will be chaired by SRO; SRO "Co-Chair" means that the SRO will co-chair the review with another organization (i.e., MSFC for GBM reviews, and DOE for some agreed-upon LAT reviews). Where reviews are co-chaired with another organization, the Co-Chairs will collaborate on a common agenda and reporting scheme.

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Table 1
GLAST Reviews and Review Objectives

REVIEW	PURPOSE/OBJECTIVE
System Requirements Review (SRR)	Evaluate the adequacy of the GLAST requirements as a basis for preliminary design: assure that appropriate plans and requirements specifications are in place, that they are documented completely, and understood. This review is also a means of validating requirements, that is, seeing that the right requirements are being used
GLAST IRT Management Review	Assess the GLAST management structure, mechanisms and processes for adequacy to develop and operate the mission.
LAT Preliminary Design Review (PDR)	Assess the preliminary instrument design, systems engineering, resource allocations and design analyses for compliance with the requirements.
GBM PDR	Assess the preliminary instrument design, systems engineering, resource allocations and design analyses for compliance with the requirements
Mission PDR	Assess the preliminary mission design, systems engineering, resource allocations and design analyses for compliance with the requirements. This review will focus on the spacecraft and overall mission designs.
Non-Advocate Review (NAR)	Provides an independent verification of GLAST's program and project plans, life-cycle cost status, and readiness to proceed to the implementation phase.
Mission Confirmation Readiness Review (MCRR)	Assess GLAST's readiness for a Mission Confirmation Review.
Mission Confirmation Review (MCR)	Evaluate the readiness of GLAST to transition from formulation to implementation including: the establishment of success criteria and acceptable risk; an acceptable project plan that includes a commitment to people, facilities, travel and other Center resources; adequate technical margins and resource reserves; and the ability to implement the mission in a disciplined manner and within the resource and schedule constraints identified.
GBM Critical Design Review (CDR)	Assess the detailed instrument design using drawings, analyses, breadboard/EM results to show that the design will meet the final performance and interface specifications and the required design objectives.
LAT CDR	Assess the detailed instrument design using drawings, analyses, breadboard/EM results to show that the design will meet the final performance and interface specifications and the required design objectives.
Mission CDR	Assess the detailed mission design using drawings, analyses, breadboard/EM results to show that the design will meet the final performance and interface specifications and the required design objectives. This review will focus on the spacecraft and mission elements other than the instruments. The instruments will be covered at a summary level, with results of their CDRs presented.
GBM Pre-Environmental Review (PER)	Evaluate the planned instrument test/calibration program and test flow to assure that it meets the program needs and to assure that a proper baseline of performance of the item to be tested has been established, and the item is ready to begin a qualification test program to demonstrate end-to-end performance.
Mission Operations Review (MOR)	The overall design and status of the ground system is reviewed to assure that the requirements for science and spacecraft operations support are understood and that the proposed approach will meet the requirements.

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REVIEW	PURPOSE/OBJECTIVE
LAT PER	Evaluate the planned instrument test/calibration program and test flow to assure that it meets the program needs and to assure that a proper baseline of performance of the item to be tested has been established, and the item is ready to begin a qualification test program to demonstrate end-to-end performance.
GBM Pre-Ship Review (PSR)	Assure that the design of the instrument has been validated through the environmental qualification and acceptance test program, that all deviations, waivers and open items have been satisfactorily dispositioned and that the instrument, along with all required documentation, operating procedures, etc., is ready for shipment to the integration contractor.
LAT PSR	Assure that the design of the instrument has been validated through the environmental qualification and acceptance test program, that all deviations, waivers and open items have been satisfactorily dispositioned and that the instrument, along with all required documentation, operating procedures, etc., is ready for shipment to the integration contractor.
Observatory PER	Evaluate the planned observatory test/calibration program and test flow to assure that it meets the program needs and to assure that a proper baseline of performance of the observatory to be tested has been established, and the observatory is ready to begin a qualification test program to demonstrate end-to-end performance.
Flight Operations Review (FOR)	Assess the final orbital operations plans as well as the compatibility of the flight components with the ground support equipment and ground networks for adequacy to fulfill the mission objectives.
Observatory PSR	Assure that the design of the observatory has been validated through the environmental qualification and acceptance test program, that all deviations, waivers and open items have been satisfactorily dispositioned and that the observatory, along with all required documentation, operating procedures, etc., is ready for shipment to the launch site for integration with the launch vehicle.
Operations Readiness Review (ORR)	Assess the status of the mission operations, ground systems and networks to support the launch and on-orbit operations of the mission.
Mission Readiness Review (MRR)	Provide the Center with an opportunity to assess the readiness of the mission for launch and on-orbit operations and to provide the documented basis for certifying to NASA Headquarters that the mission is ready for launch.
Flight Readiness Review (FRR)/Launch Readiness Review (LRR)	Assess the overall readiness of the mission to launch and to support the flight objectives of the mission.

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Table 2:
Review Matrix
(Note: Dates are subject to change.)

REVIEW	APPROXIMATE DATE	CHAIRMAN	OBSERVERS
SRR	September 27-28, 2000	SRO Chair	
GLAST IRT Management Review	December 5, 2001	OSS IRT Chair	SRO, DOE
LAT PDR	January 8 - 11, 2002 Delta PDR July 30 – August 1, 2002	SRO/DOE Co-Chairs	OSS IRT
GBM PDR	April 9 - 11, 2002	SRO/MSFC Co-Chairs	OSS IRT
Mission PDR	April 2003	SRO Chair	DOE, OSS IRT
NAR	April 2003	OSS IRT Chair	SRO, DOE
MCCR	June 2003	GSFC PMC Chair	
MCR	June 2003	EAA	
GBM CDR	June 2003	SRO/MSFC Co-Chairs	OSS IRT
LAT CDR	April 2003	SRO/DOE Co-Chairs	OSS IRT
Mission CDR	February 2004	SRO Chair	DOE, OSS IRT
GBM PER	October 2004	SRO/MSFC Co-Chairs	OSS IRT
MOR	December 2004	SRO Chair	DOE, OSS IRT
LAT PER	January 2005	SRO Chair	OSS IRT, DOE
GBM PSR	April 2005	SRO/MSFC Co-Chairs	OSS IRT
LAT PSR	July 2005	SRO Chair	OSS IRT, DOE
Observatory PER	December 2005	SRO Chair	OSS IRT, DOE
FOR	December 2005	SRO Chair	OSS IRT, DOE
Observatory PSR	April 2006	SRO Chair	DOE, OSS IRT
ORR	May 2006	SRO Chair	DOE, OSS IRT
MRR	August 2006	GLAST PMC Chair	
FRR/LRR	September 2006	KSC	DOE, SRO, OSS IRT

The NASA Headquarters has chartered an Independent Review Team (IRT) for GLAST that will also conduct reviews of the Project. This IRT's charter represents the agreement between the Associate Administrator for the Office of Space Science (OSS) and the Independent Program Assessment office (IPAO) at the Langley Research Center regarding the charter, performance characteristics, operating principles, and composition of the review team. Where NASA Headquarters and their IRT determine that the OSS IRT should conduct a review coincident with an SRO Review, it is expected that the two teams, through their respective Chairs, will collaborate on a common agenda and jointly conduct the reviews, and that the two review teams will issue a common set of RFAs to the project team.

In consultation with the GLAST Project Manager, the SRO Chair or Co-Chair will invite the other review team members (MSFC, DOE, OSS IRT) to participate as observers, as appropriate. TBD has been designated as the GLAST SRO Chair.

In addition, GSFC is responsible for the development of the Anti-Coincidence Detector (ACD) subsystem of the LAT, which will be delivered to SLAC for integration onto the LAT

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instrument. The SRO, in accordance with GPG 8700.4, will conduct a CDR, PER and PSR for ACD.

3. Scope of GLAST Reviews

The mission elements that will be addressed by the SRO reviews shall be as follows: spacecraft; payload; launch vehicle interfaces/integration; mission unique changes and first flight items for the launch vehicle; ground system, and mission operations; data capture, analysis and distribution.

4. Content of Reviews

The primary purpose of independent reviews is to provide expert technical review of the end-to-end mission system. Through the planned series of reviews, the review team(s) shall evaluate the adequacy of the planning, design, implementation and associated processes to successfully accomplish the mission requirements. The Independent Reviews listed above will be supported by a comprehensive set of peer reviews and Project internal reviews, as appropriate, in accordance with GPG 8700.6. GLAST's peer review process is documented in the GLAST Engineering Peer Review Plan. The SRO Chair may choose to attend these reviews with a small team as deemed appropriate by the SRO. The attendance at these reviews would be as Observers.

The SRO Review Team shall assess the performance of the project using the following primary sources of requirements:

- GLAST Program Plan, 433-PLAN-0008
- GLAST Project Plan, 433-PLAN-0001
- NPG 7120.5, NASA Program and Project Management Processes and Requirements

These documents may contain references to other requirements and planning documentation.

As part of the Independent Review process, the SRO Review Team shall:

- Confirm the documentation of and assess the compatibility of the success criteria, acceptable risk and allocated resources
- Evaluate the technical content, schedule, staffing and cost of the project over the entire life cycle
- Assess system resource management and margins (e.g., mass, power, propellant)
- Assess technical progress, risks remaining and mitigation plans
- Assess progress/milestone achievement against approved baselines
- Determine if any deficiencies exist that result in revised projections exceeding predetermined thresholds
- Evaluate the utilization of past lessons learned and the capture of new knowledge
- Assess and provide a recommendation for the launch readiness of the mission.

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The GLAST Project Manager and SRO Review Team will utilize the GSFC Project Management Checklist as a guide for topics to be addressed during the reviews. Special attention will be provided to the plans and results for the GSFC Systems Management Process areas shown in Attachment A.

5. Reporting and RFA Closure

The Review Team shall brief the GLAST Project team on their initial impressions and the Requests for Action (RFAs) generated at the conclusion of each review. The Chair or Co-Chairs shall issue the final report and RFAs to the Project Manager with a copy to the Program Manager and GSFC SMO Director within 3 weeks of each review. The report content will be in accordance with GPG 8700.4.

The GLAST Project shall report the summary results of all Independent Reviews to the GSFC PMC during the Monthly Status Review following each review. The Project will provide RFA responses to the Chair or Co-Chairs of the Review; the Chair or Co-Chairs will ensure that members of the Review Board(s) and the originator of each RFA are provided a copy of the RFA response for closure. If the RFA response is considered to be inadequate by the Review Board and originator, the GLAST Project Manager will be notified and will determine what further action is necessary. RFA status, including any open RFAs, will be presented as a standard part of the subsequent reviews.

The SRO Chair shall formally present the results of the assessments, evaluation of residual risks and a final recommendation of mission readiness to the GSFC PMC at the Mission Readiness Review.

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<u>IIRT Assessment of Key Systems Management Practices</u>						
<i>Evaluation Criteria</i>	<i>Review Milestone</i>					
	<i>SRR</i>	<i>SCR</i>	<i>PDR</i>	<i>CDR</i>	<i>PER</i>	<i>PSR</i>
Organization and Staffing: A suitable and workable organizational structure is in place. Roles and responsibilities are clearly defined. The current and planned number, capability, and experience of people assigned are sufficient. The project team communicates (internally and externally) in a full and open manner and demonstrates the behaviors of a learning organization.						
Systems Management: Thorough processes have been planned and implemented for key functions, such as: requirements management (derivation and functional allocation), systems engineering, risk management, configuration management, documentation and technical record keeping, conduct of analyses, workmanship, and verification process management.						
Safety: Personnel, facility, launch range, and mission safety considerations are thoroughly considered. Hazards are defined. Controls and verifications are implemented. Documentation is approved.						
Risk Management: A rigorous risk management process has been rigorously applied. Appropriate mitigations have been undertaken. Adequate Failure Mode and Effects Analysis (FMEA), Fault Tree Analysis (FTA), and, where indicated, Probabilistic Risk Assessment (PRA) has supported the effort. Appropriate design changes have been undertaken as a result of such analyses. Single point failures, where retained, have reasonable supporting rationale. Risk implications of test failures have been considered.						
Mission Assurance: The planning and execution of mission assurance requirements, including EEE parts, materials, workmanship standards, and software assurance (including IV&V) has been rigorous. A comprehensive, closed-loop problem reporting and corrective action system is utilized.						
Integration: Physical and analytic integration activities for all hardware and software elements of the mission, including ground equipment and the launch vehicle, have been well planned and executed. Appropriate assessment of all applicable discrepancies and confirmation of adequate closeout has preceded each integration step.						

<i>Evaluation Criteria</i>	<i>Review Milestone</i>					
	<i>SRR</i>	<i>SCR</i>	<i>PDR</i>	<i>CDR</i>	<i>PER</i>	<i>PSR</i>
Verification: Validation and verification activities (analysis, inspection, and test) associated with software and hardware elements at all levels of assembly have been well planned and executed. A verification matrix is utilized to track and confirm results and compliance with requirements. Trend analysis of key parameters is utilized. Total and failure-free run times of primary and redundant elements are adequate.						
Operations: Operations considerations have been adequately planned and implemented. A mission timeline, from launch through disposal, exists and defines corrective actions needed for mission events that fail to occur as planned. The fidelity of simulations has been comprehensive and thorough and has included contingency and emergency actions by the operations team.						
Peer Reviews: A comprehensive and thorough set of engineering peer reviews has been planned and conducted on appropriate hardware and software elements of the project by competent and independent people. Results and actions have been documented and communicated to the project manager and Integrated Independent Review Team.						
Integrated Independent Reviews: Planning and presentation of information at critical mission and major element milestone reviews has been rigorous; peer review results have been included in briefings; review success criteria have been met; closeout of all review actions has been timely and thorough.						

Legend: **Green** - To date, activities are fully compatible with good practice for similar successful projects.

Yellow - To date, activities exhibit weakness that warrants change to control risk.

Red - To date, activities are deficient and immediate corrective action is essential to minimize risk.

IIRT Assessment of Key Systems Management Practices (Continued)***Explanatory Notes Associated with above IIRT Evaluation***

<i>Note #</i>	<i>Review</i>	<i>Applicable Criteria</i>	<i>IIRT Recommendation/Observation</i>